Solution to Exercise 5.11.1

In discrete-time signal processing, an amplifier amounts to a multiplication, a very easy operation to perform.

Solution to Exercise 5.12.1

The indices can be negative, and this condition is not allowed in MATLAB. To fix it, we must start the signals later in the array.

Solution to Exercise 5.12.2

Such terms would require the system to know what future input or output values would be before the current value was computed. Thus, such terms can cause difficulties.

Solution to Exercise 5.13.1

It now acts like a bandpass filter with a center frequency of f_0 and a bandwidth equal to **twice** of the original lowpass filter.

Solution to Exercise 5.14.1

The DTFT of the unit sample equals a constant (equaling 1). Thus, the Fourier transform of the output equals the transfer function.

Solution to Exercise 5.14.2

In sampling a discrete-time signal's Fourier transform L times equally over [0, 2π) to form the DFT, the corresponding signal equals the periodic repetition of the original signal.

$$\left(S(k) \leftrightarrow \sum_{i=-\infty}^{\infty} (s(n - iL)) \right)$$

(5.57)

To avoid aliasing (in the time domain), the transform length must equal or exceed the signal's duration.

Solution to Exercise 5.14.3

The difference equation for an FIR filter has the form

$$y(n) = \sum_{m=0}^{q} (b_m x(n - m))$$

(5.58)

The unit-sample response equals

$$h(n) = \sum_{m=0}^{q} (b_m \delta(n0m))$$

(5.59)